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Nanoscale Characterisation of Thin Film Adhesion Layers

Mario Frederik Heinig^{*1}, Matteo Todeschini¹, Johneph Sukham², Radu Malureanu², Alice Bastos da Silva Fanta¹, Henri Jansen¹, Jakob Birkedal Wagner¹, Shima Kadkhodazadeh¹

¹ DTU Cen/Danchip, Technical University of Denmark, Kgs. Lyngby, Denmark

² DTU Fotonik, Technical University of Denmark, Kgs. Lyngby, Denmark

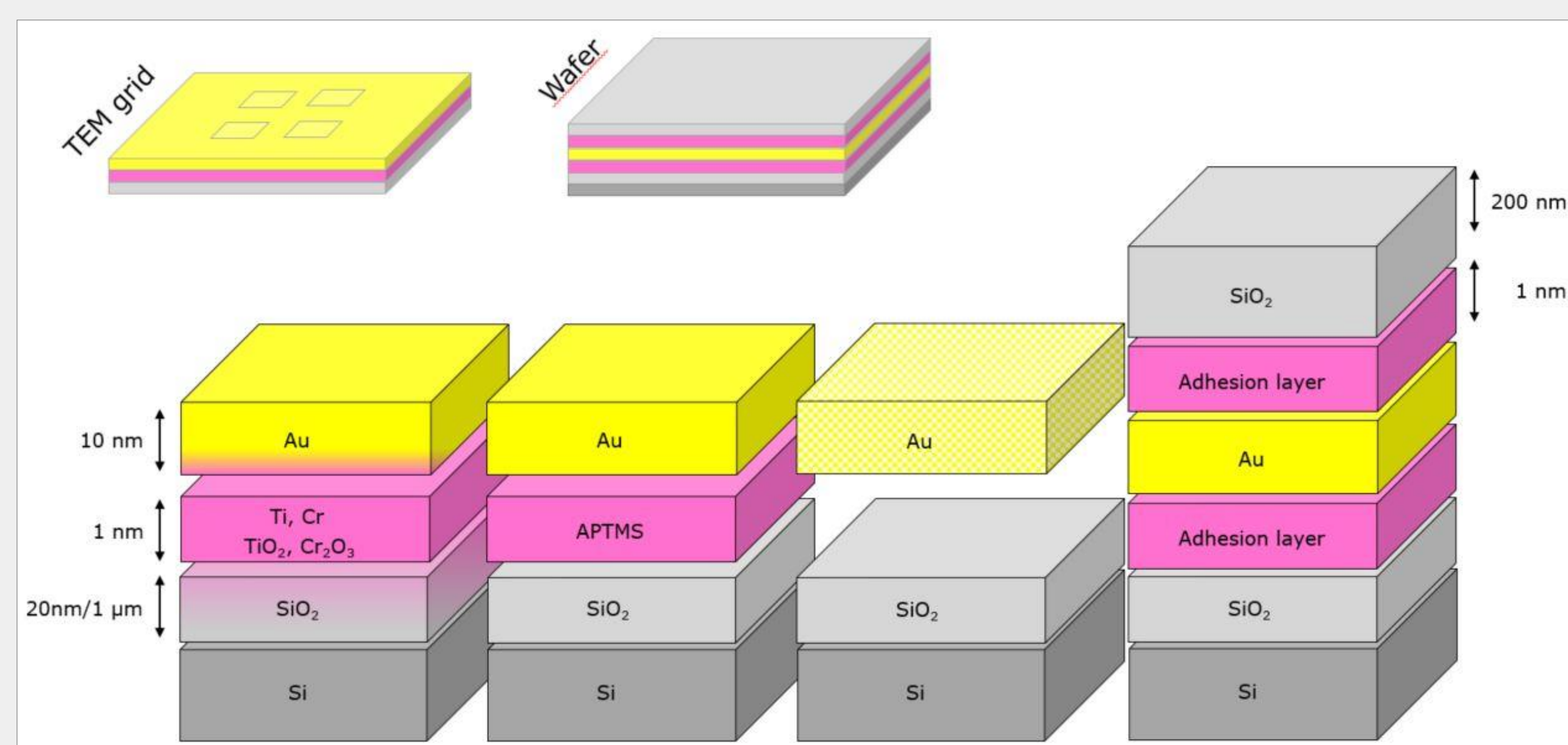
* E-mail: marhein@dtu.dk

Motivation and background

In the field of plasmonic and microelectronic devices, the fabrication of noble metal films on dielectric or semiconductor substrates requires an adhesive intermediate layer that guarantees the stability of the structure. The most common materials for this purpose are the metallic adhesion layers Cr or Ti. However, they deteriorate the optical characteristics of ultra-thin and ultra-smooth layers for plasmonic waveguides and hyperbolic metamaterials. Here, we investigate the adhesion mechanism between gold and silicon oxide substrates, comparing the classical Cr and Ti adhesion layers with the aminosilane APTMS (3-aminopropyl)trimethoxysilane, to establish an improved understanding of the structural effects and material properties.

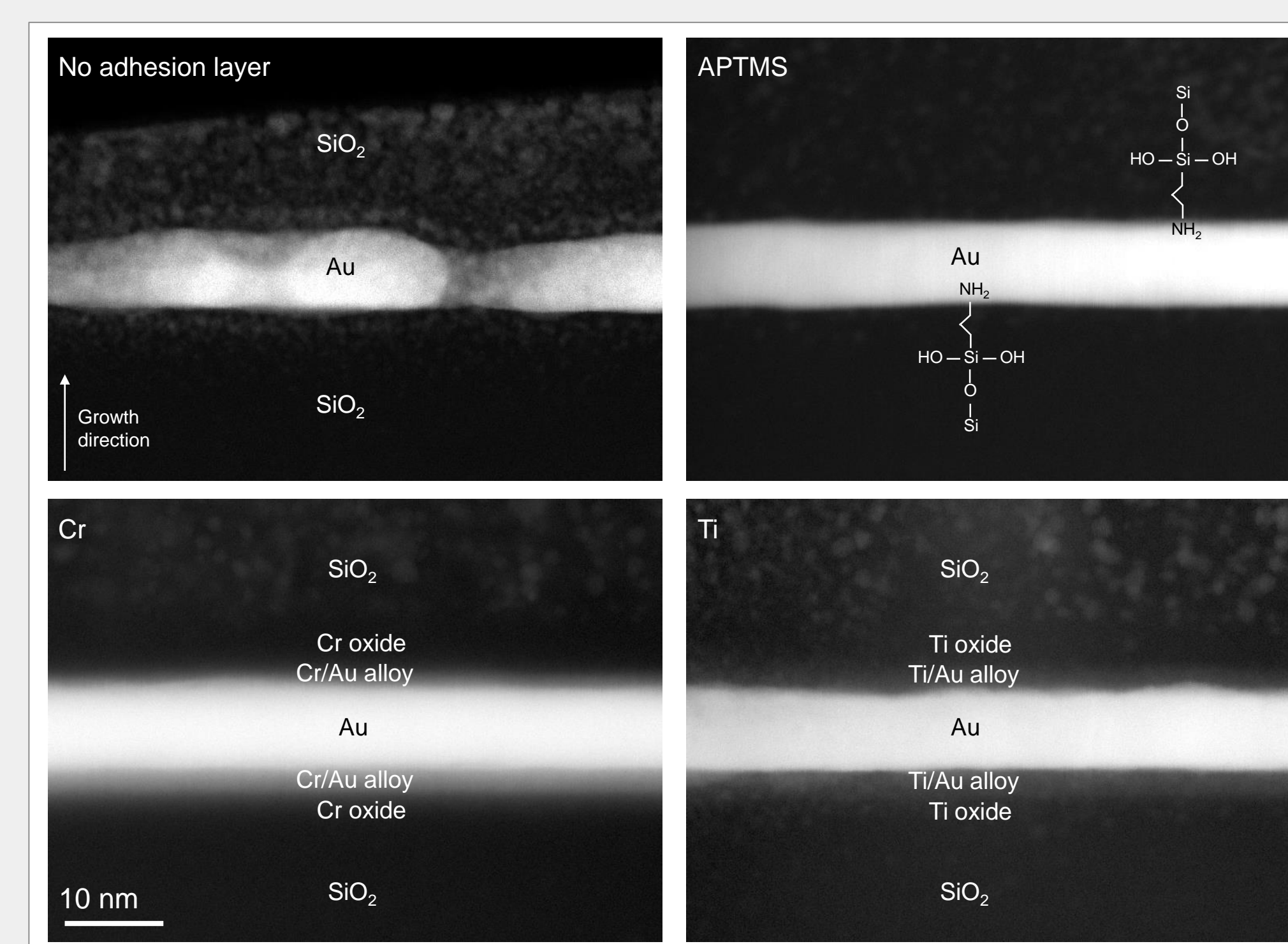
Samples

Au films were deposited on silicon oxide **TEM grids** and **wafers**, using two different deposition techniques, **E-beam evaporation** Wordentec QCL800 and **Sputtering system** LESKER. The single layers on TEM grids were examined in plan-view geometry and the double layers on wafers were examined in cross-sectional geometry.



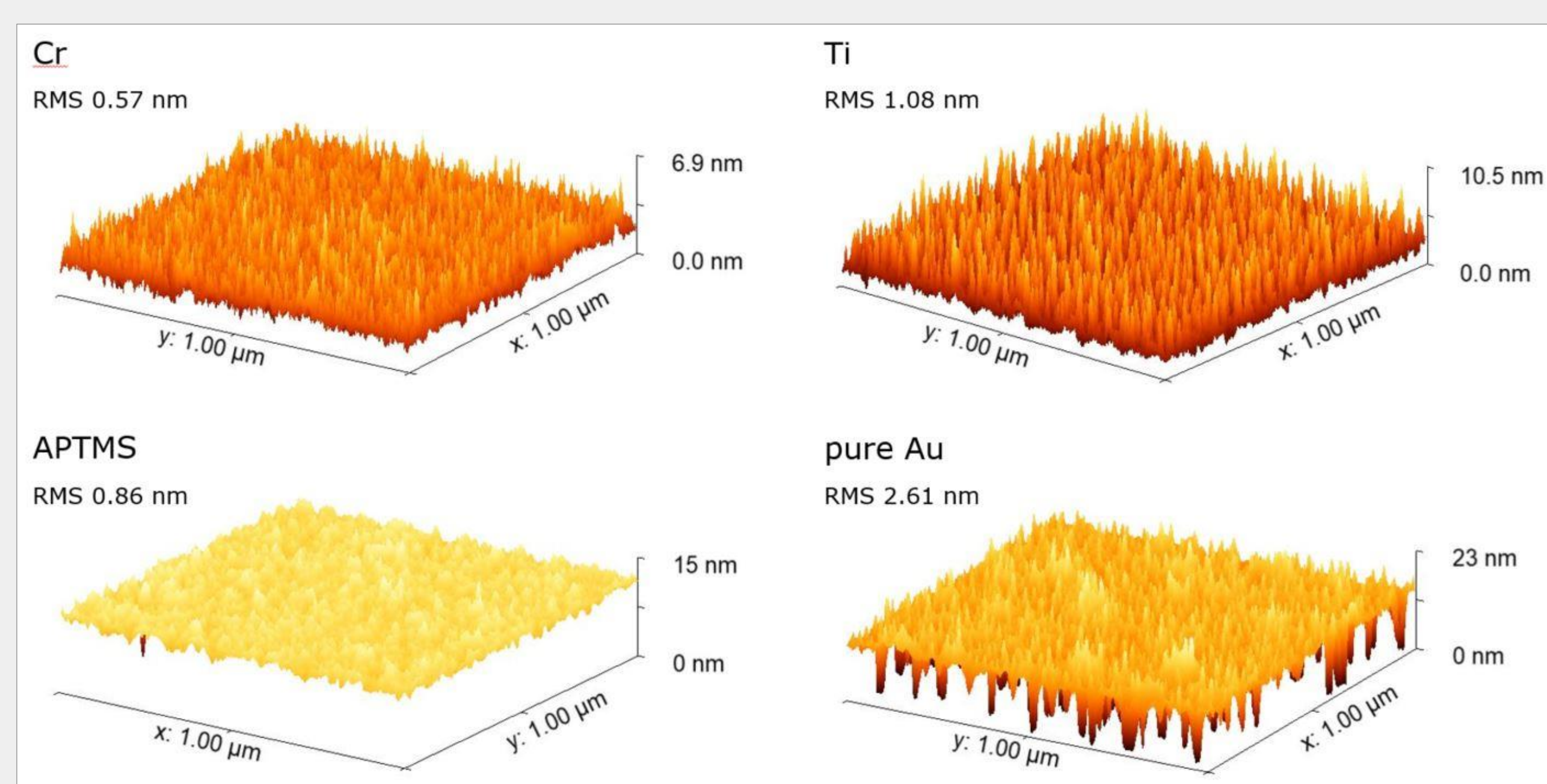
Chemistry and optical properties

Electron energy-loss spectroscopy (EELS) scans of TEM window grids with dampening effects of the metallic adhesion layers, while the organosilane contains the plasmonic signal.

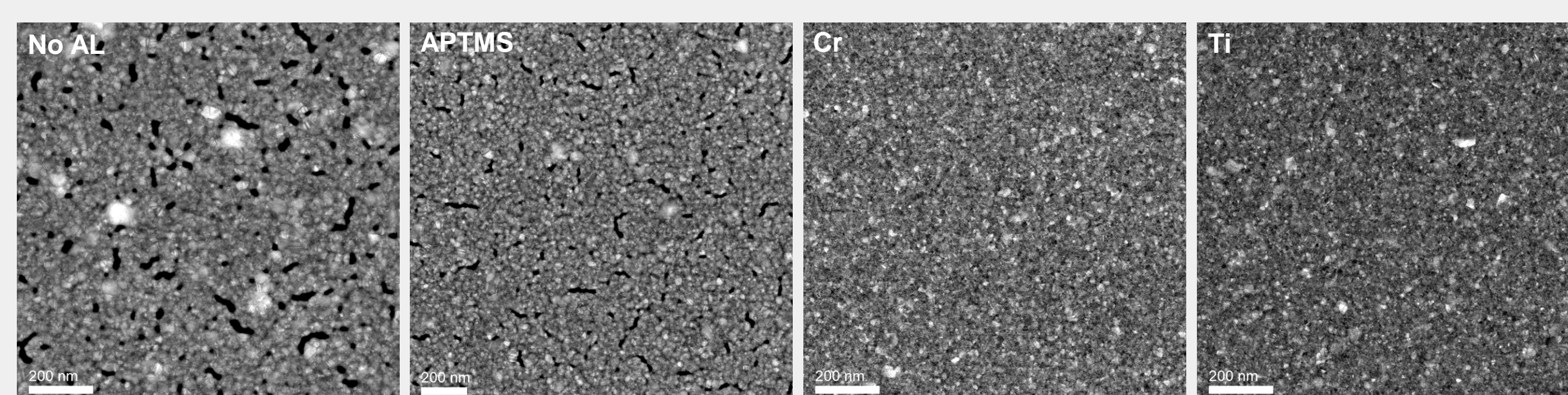


Morphology

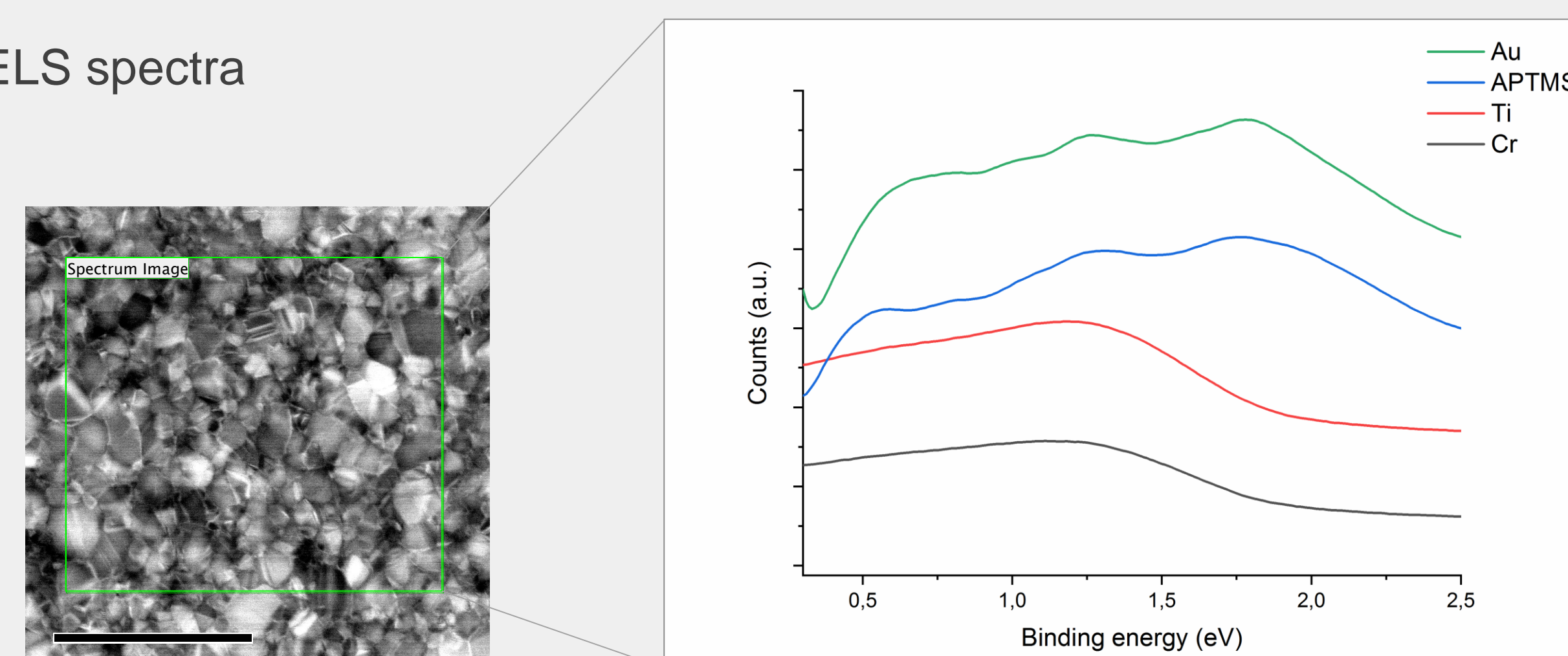
Atomic force microscopy (AFM):



ADF STEM:



EELS spectra



Conclusion and Outlook

We conducted comprehensive studies on effects of adhesion layers on Au thin films and propagating plasmonic modes. The results present promising tendencies of the ultrathin film coverage, grain size distribution, film quality and plasmonic interactions. Further High-resolution TEM (HRTEM), transmission Kikuchi diffraction (TKD) and electron energy-loss spectroscopy (EELS) will be used to understand and compare the morphology, microstructure and chemistry of the thin films. After elaboration the most promising fabrication method, further organosilanes will be investigated with respect to optical and mechanical properties in order to avoid the dampening influences of metallic adhesion layers for more advanced plasmonic applications in the future.

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